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Hong et al.

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(54) **VALVE ACCELERATING TYPE DISPENSING PUMP**

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B05B 1/30 (2006.01)
F04B 7/00 (2006.01)

(52) **U.S. Cl.**

CPC ***F04B 7/0061*** (2013.01)
USPC **222/559**; 222/63; 222/333; 222/340; 222/409; 222/504; 222/404; 156/578; 239/583; 118/300

(58) **Field of Classification Search**

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USPC 222/63, 256, 262–263, 251, 333, 340, 222/380, 409, 504, 559, 404; 118/330, 323, 118/300; 156/578; 239/583, 584
See application file for complete search history.

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(57) **ABSTRACT**

A dispensing pump, and more particularly, a valve accelerating type dispensing pump that may be used in a process of manufacturing an electronic product and may dispense an accurate amount of a liquid, such as a liquid synthetic resin, at high speed. The present invention provides a valve accelerating type dispensing pump that can descend a valve rod at high speed and thus can dispense a liquid with high viscosity at high speed. The valve accelerating type dispensing pump can dispense an accurate amount of a liquid at high speed. Also, the valve accelerating type dispensing pump can dispense a liquid having high viscosity at high speed due to a fast descending speed of a valve rod.

11 Claims, 8 Drawing Sheets

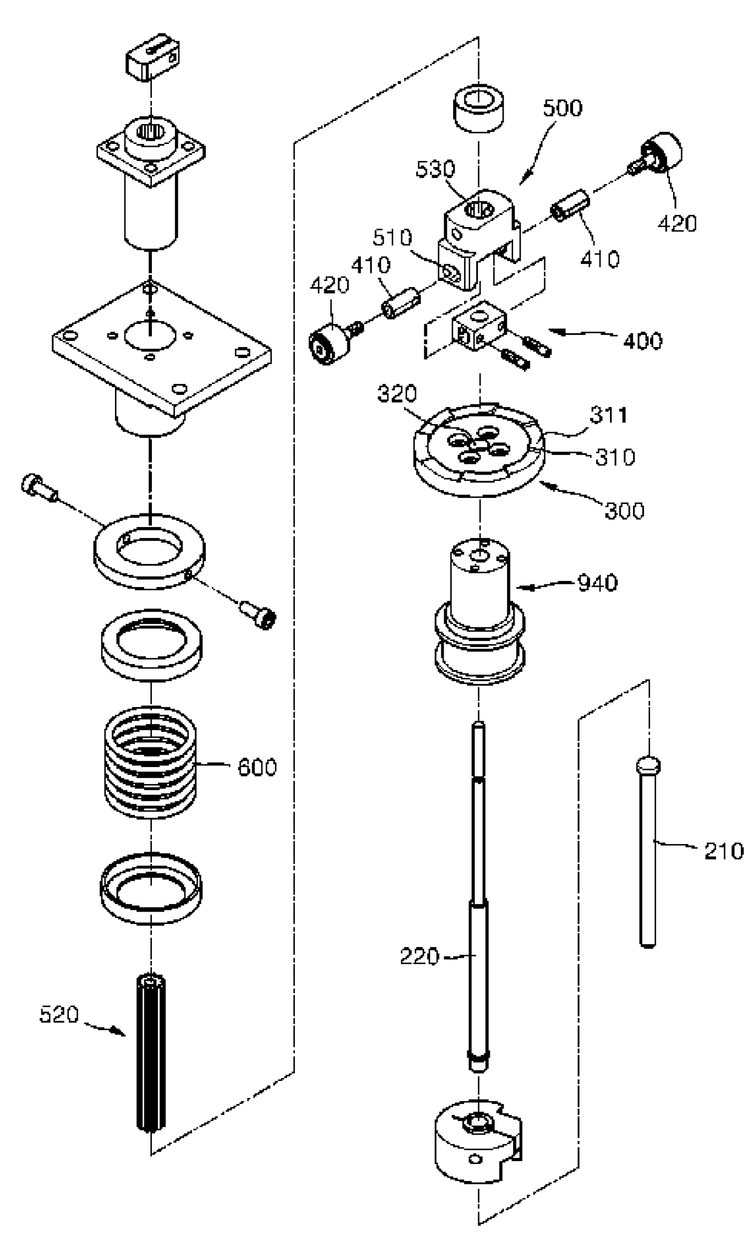


FIG. 1

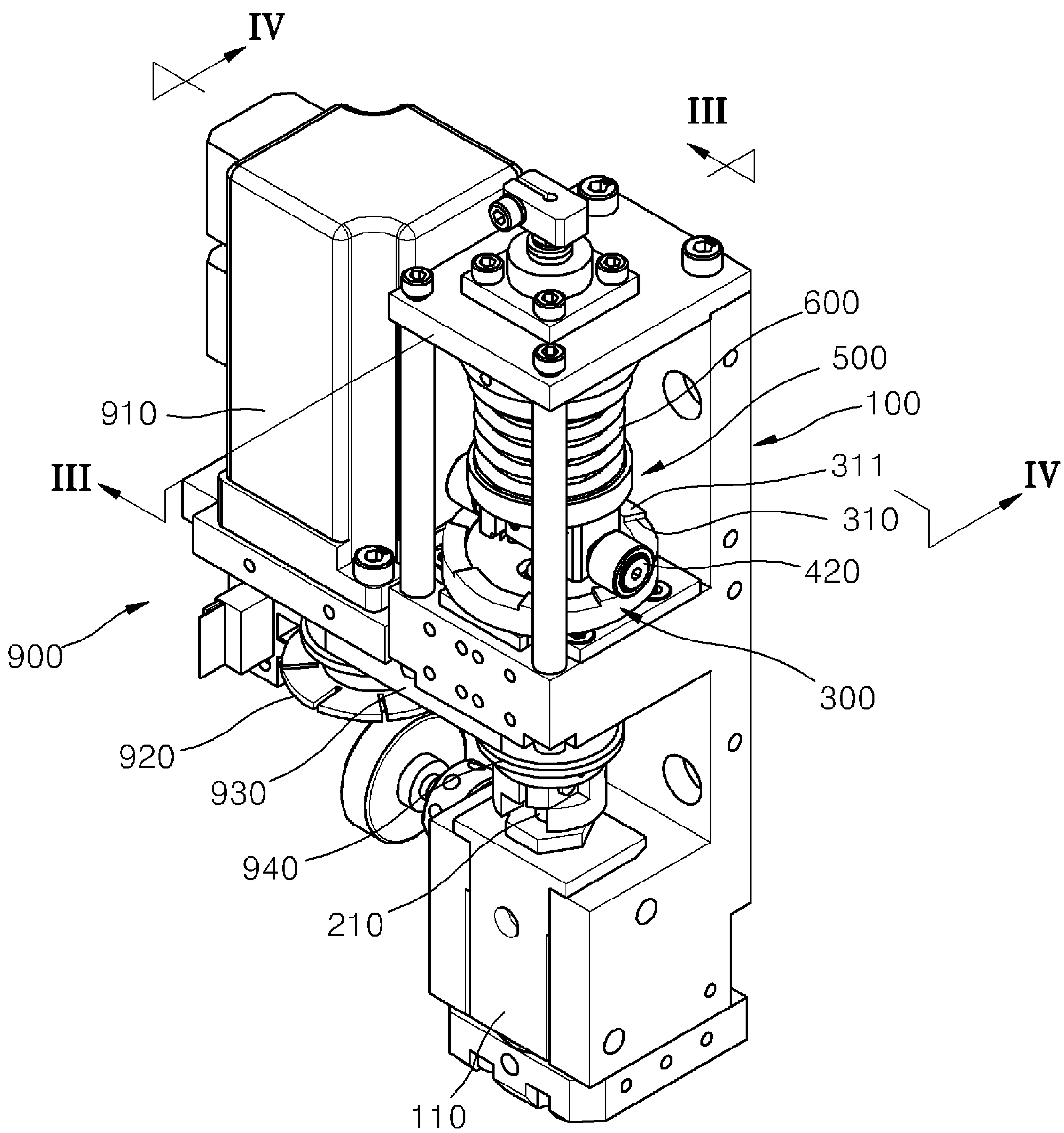

IV
III
600
500
100
910
311
III
310
IV
420
900
300
920
930
940
210
110

FIG. 2

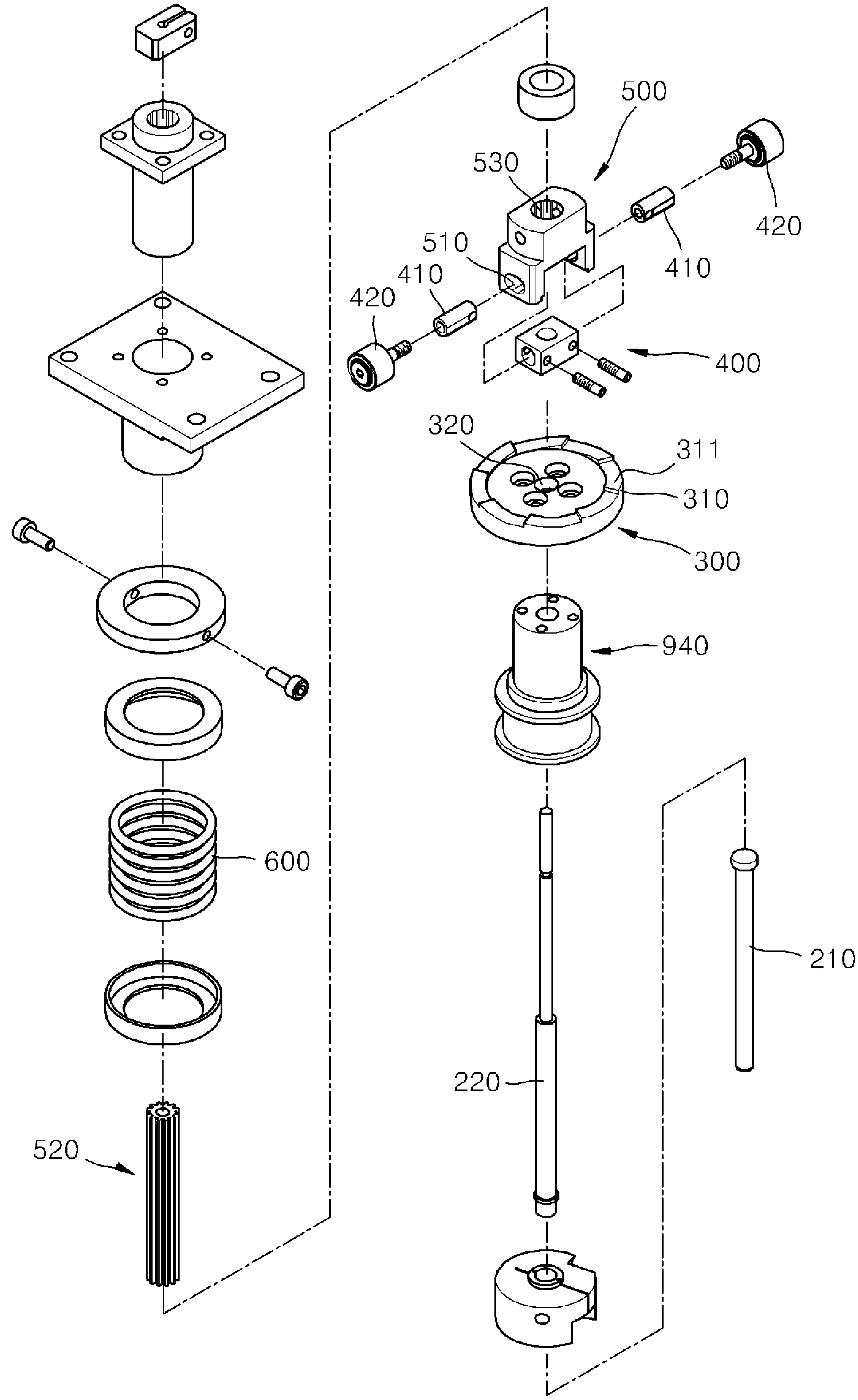

500
530
420
410
510
410
420
400
320
311
310
300
940
600
210
220
520

FIG. 3

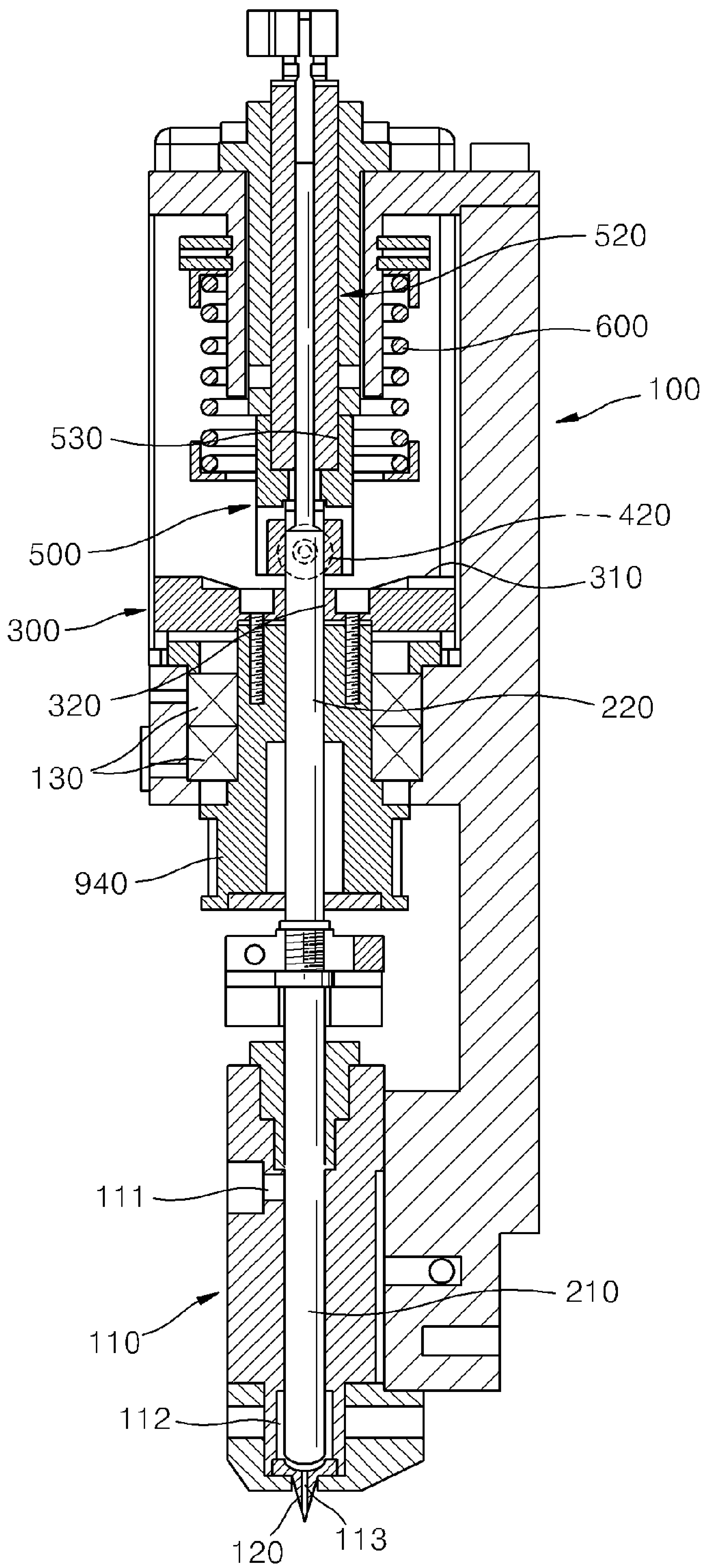
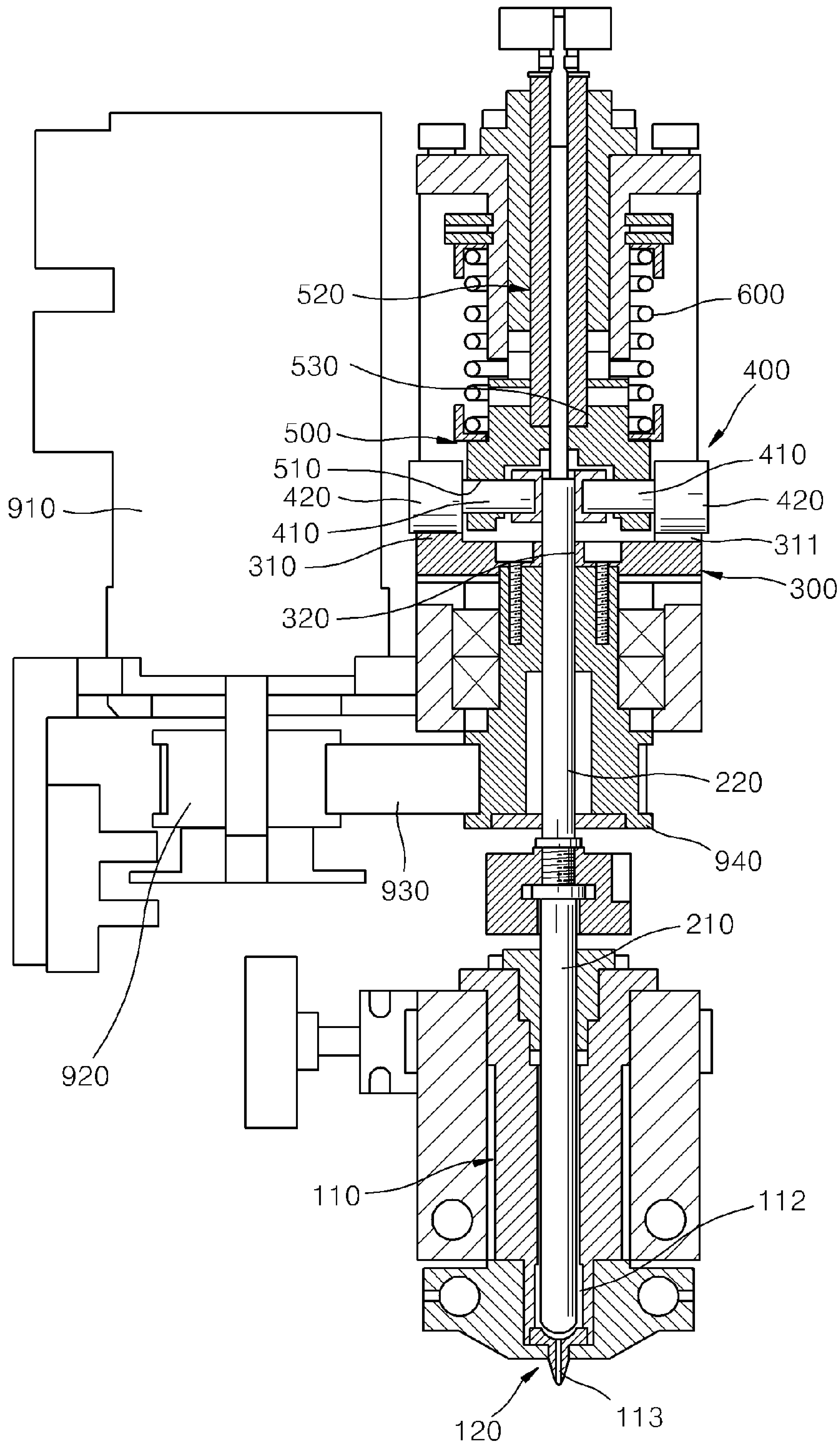

520
600
100
530
420
500
310
300
320
220
130
940
111
210
110
112
120
113

FIG. 4



520
600
530
400
500
510
410
420
420
410
910
311
310
300
320
220
940
930
210
920
110
112
120
113

FIG. 5A

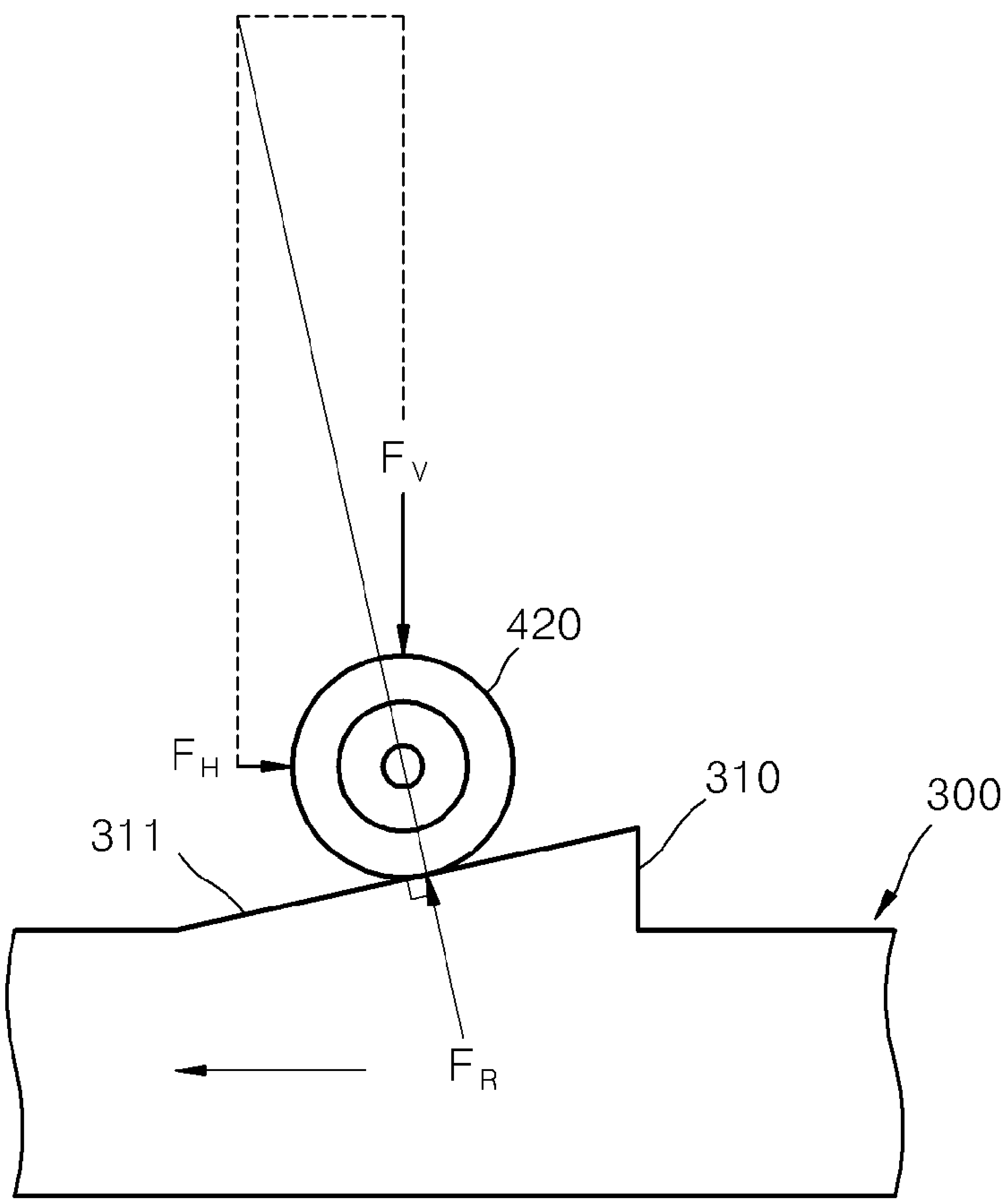


FIG. 5B

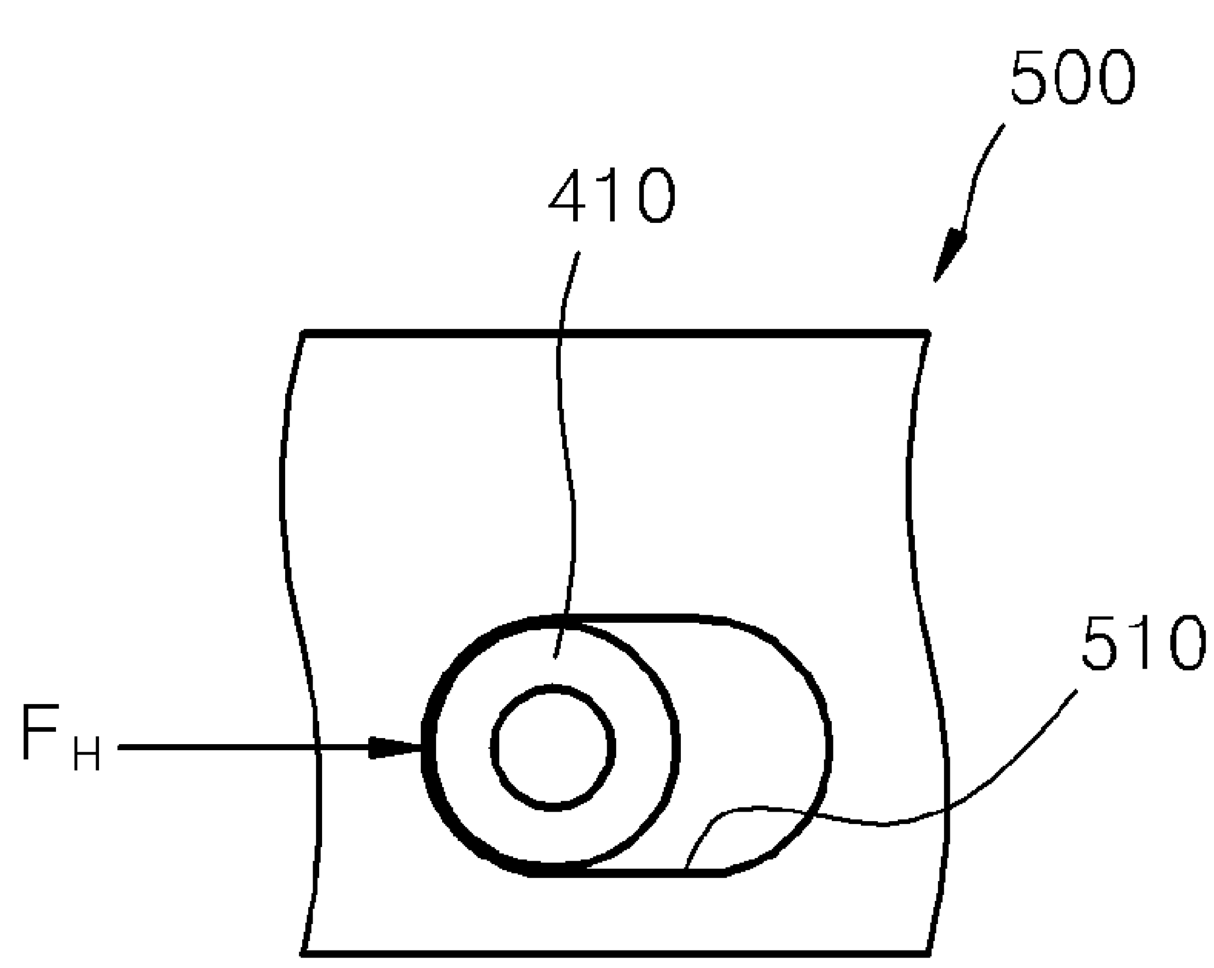


FIG. 6A

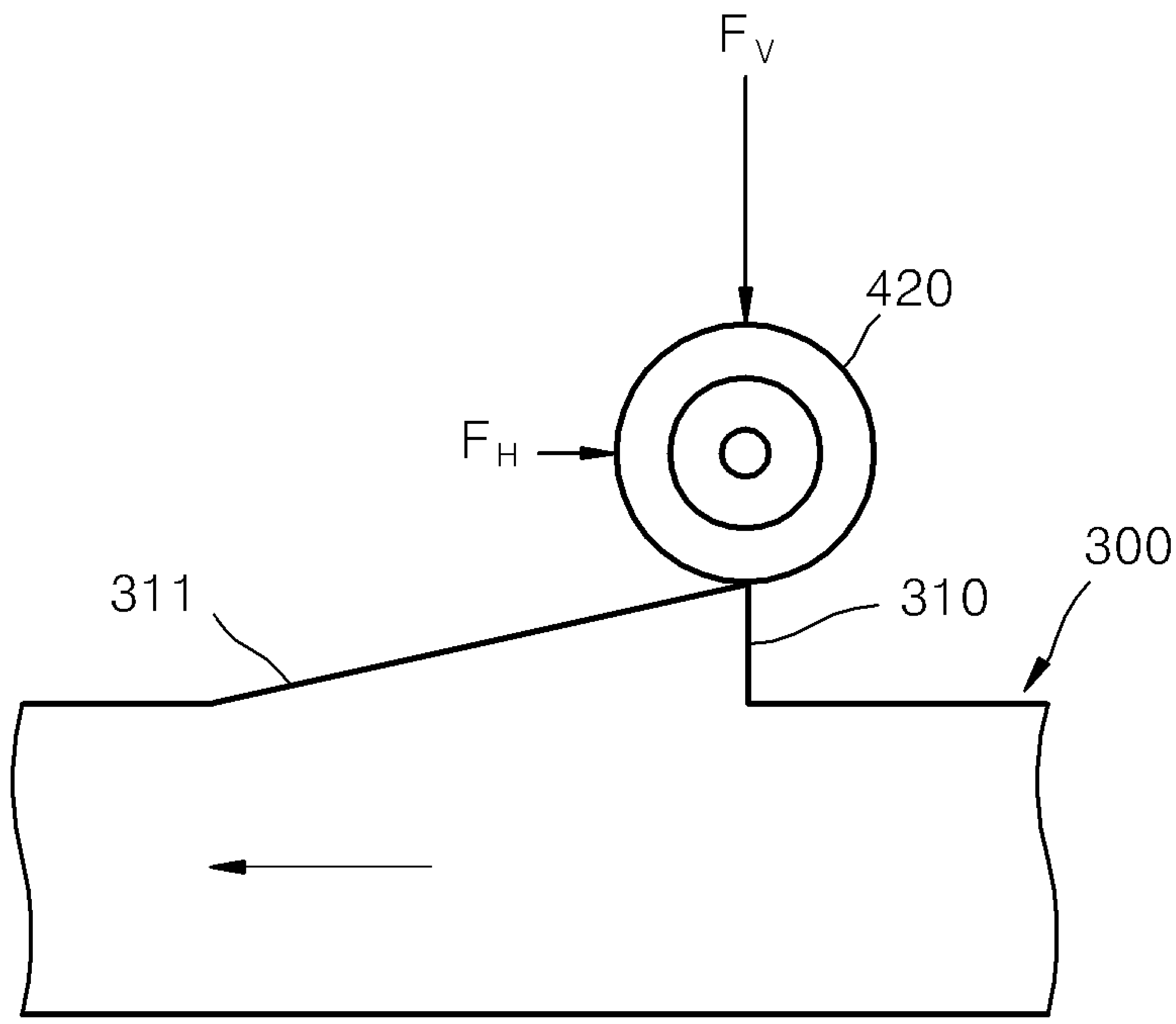


FIG. 6B

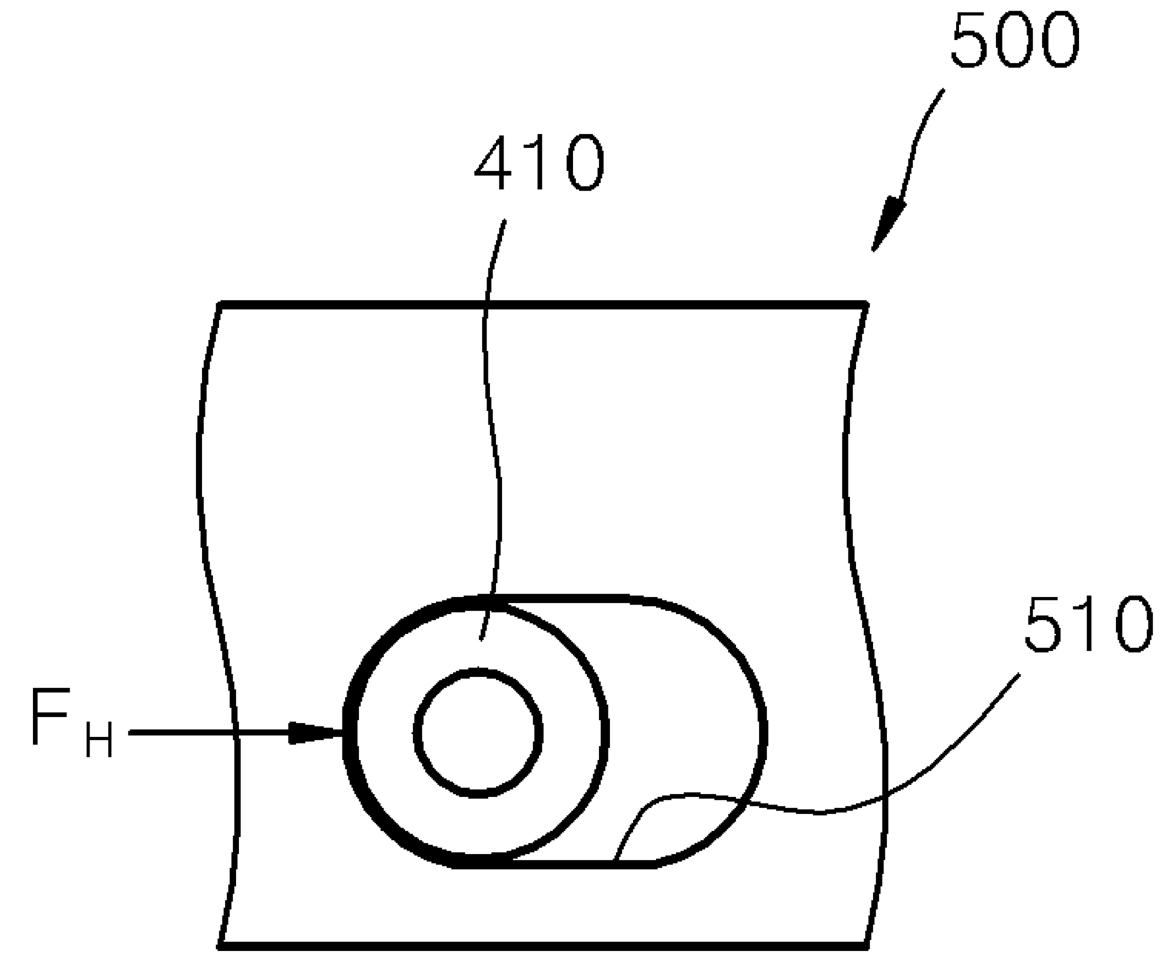


FIG. 7A

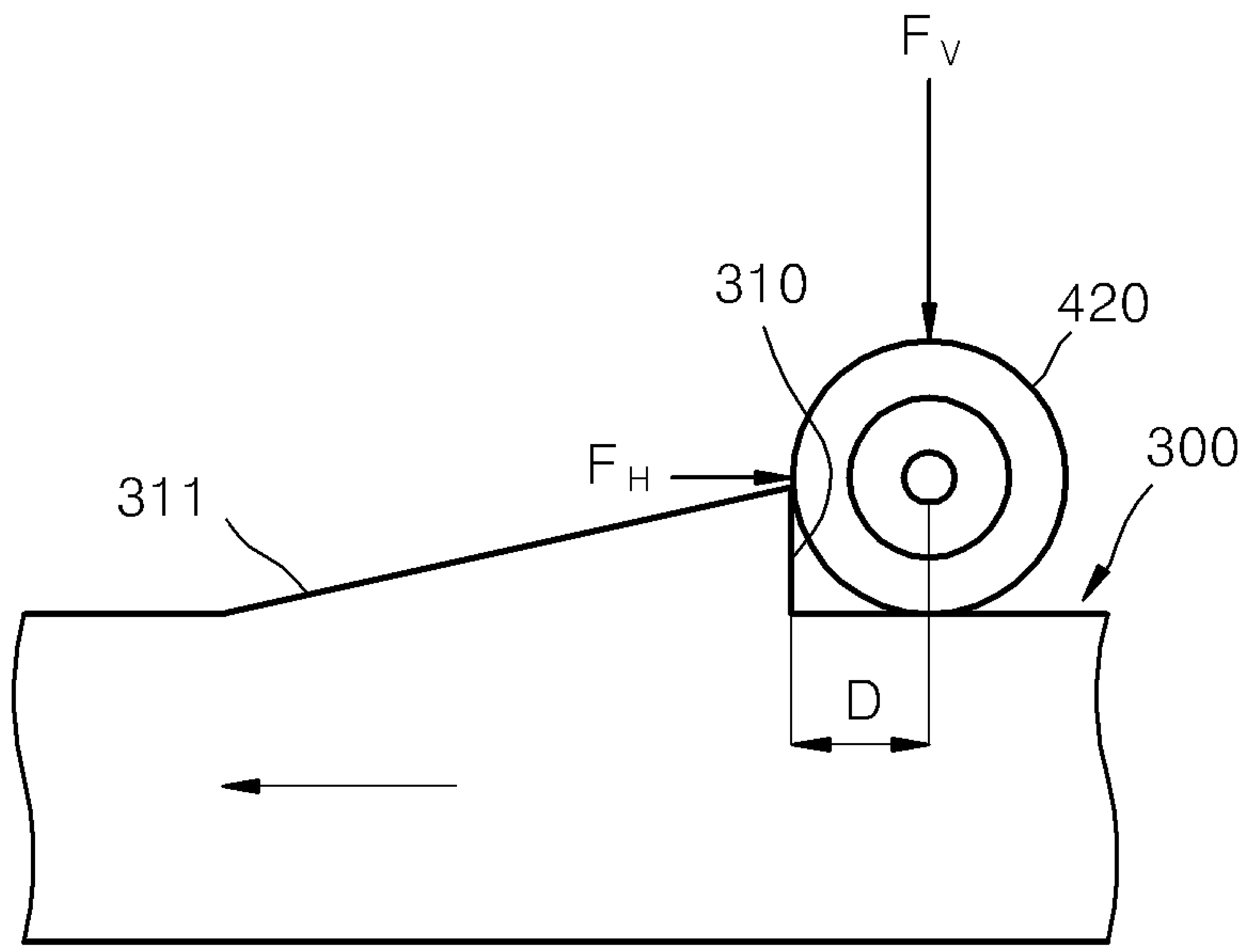


FIG. 7B

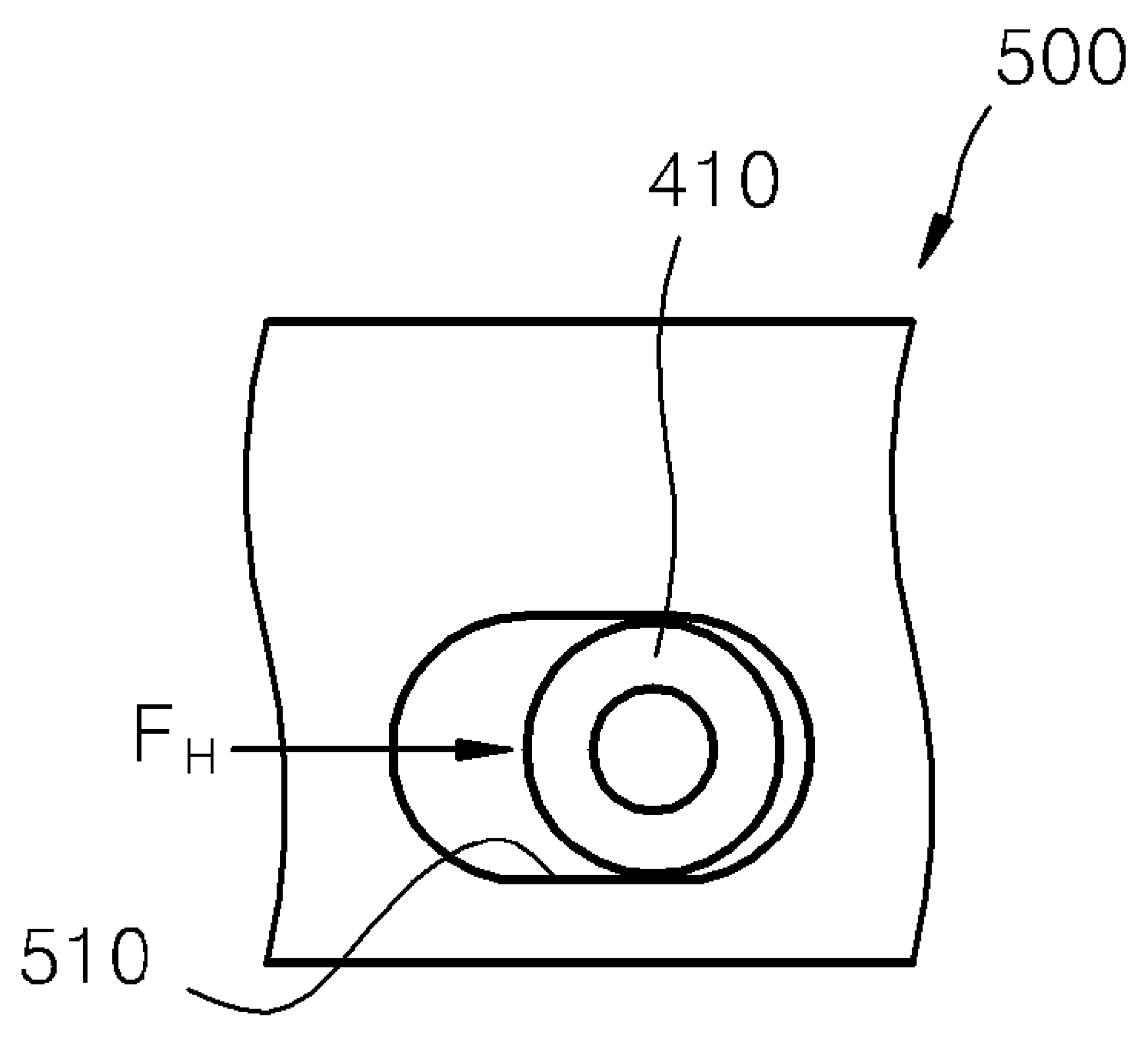
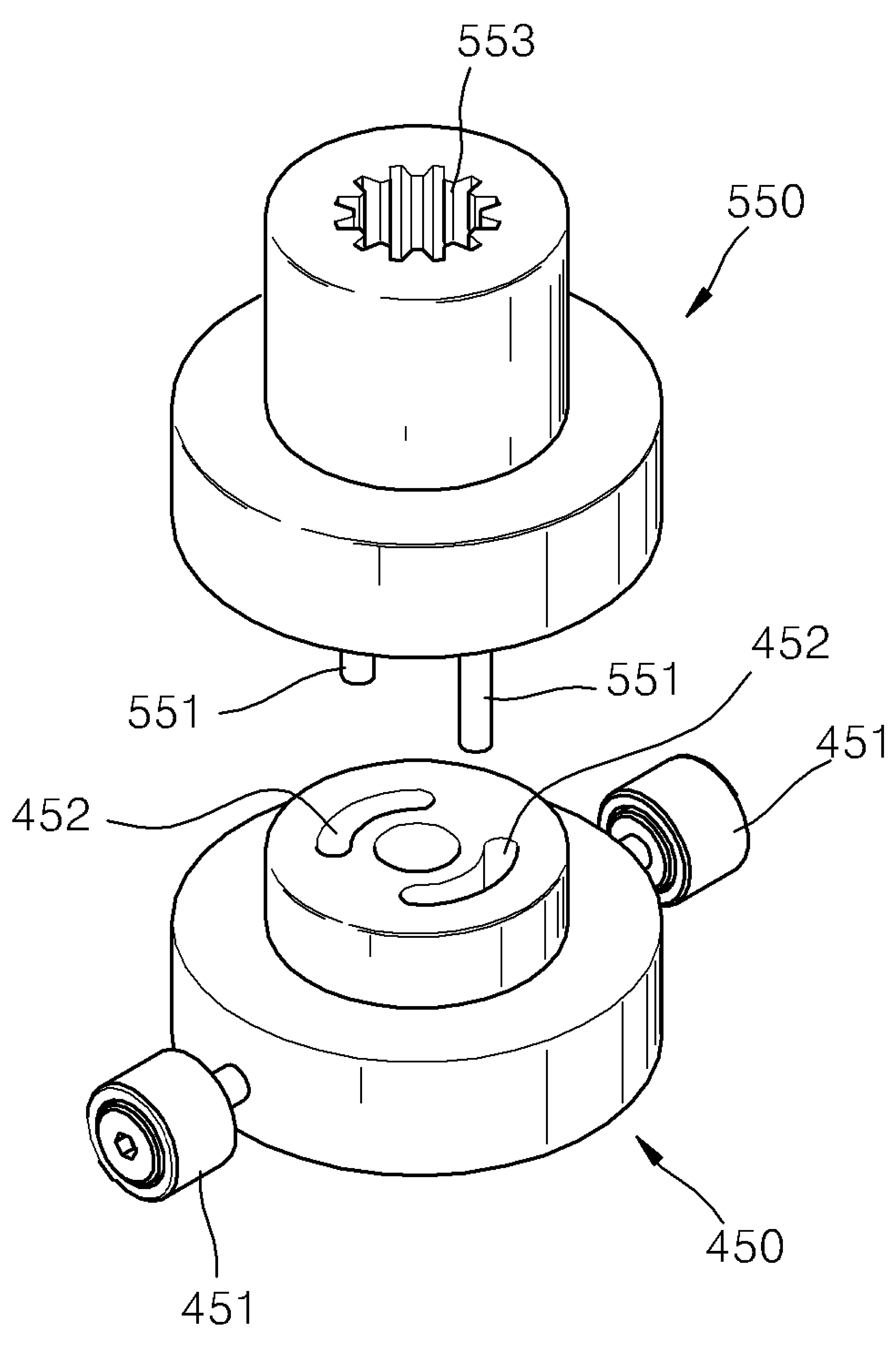


FIG. 8



VALVE ACCELERATING TYPE DISPENSING PUMP

CROSS-REFERENCE TO RELATED PATENT APPLICATION

This application claims the benefit of Korean Patent Application No. 10-2012-0055122, filed on May 24, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein in its entirety by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a dispensing pump, and more particularly, to a valve accelerating type dispensing pump that is used in a process of manufacturing an electronic product and may dispense an accurate amount of a liquid, such as a liquid synthetic resin, at high speed.

2. Description of the Related Art

Pumps for dispensing liquid are used in various technical fields, such as processes of manufacturing electronic products by using semiconductor chips, and the like.

In particular, dispensing pumps are widely used in an underfill process of a semiconductor process. The underfill process is usually used in a surface mounting technique, such as a flip chip in which a plurality of metal balls are formed on a surface facing a substrate and which electrically connects the substrate and a semiconductor chip via the plurality of metal balls. If a liquid synthetic resin is applied onto a circumference of the semiconductor chip, the resin is dispersed into a space between the semiconductor chip and the substrate by a capillary phenomenon and is filled in a space between the metal balls. The resin that fills the space between the semiconductor chip and the substrate is hardened so that adhesive strength between the semiconductor chip and the substrate can be improved. In addition, the hardened resin serves as a shock absorber and dissipates heat generated in the semiconductor chip.

A function of dispensing a liquid at high speed of such dispensing pumps becomes significant. Korean Patent Laid-open Publication Nos. 10-2005-0093935 and 10-2010-0045678 disclose a structure of a pump for dispensing a resin by ascending/descending a valve due to interaction between a cam and a cam follower. Such dispensing pumps according to the related art have excellent performance but have a limitation in speed at which a valve rod descends due to a structure of cam protrusions of a cam member and a structure of a roller. Thus, there are some difficulties in dispensing the liquid at high speed, and in particular, it is difficult to dispense a liquid with high viscosity at high speed.

SUMMARY OF THE INVENTION

The present invention provides a valve accelerating type dispensing pump that may descend a valve rod at high speed and thus may dispense a liquid with high viscosity at high speed.

According to an aspect of the present invention, there is provided a valve accelerating type dispensing pump including: a pump body; a valve body including an inlet path on which a liquid from an outside is supplied, a reservoir in which the liquid supplied via the inlet path is stored, and a discharge path on which the liquid stored in the reservoir is discharged, the valve body being installed at the pump body; a valve rod pressurizing the liquid stored in the reservoir of the valve body and inserted in the reservoir of the valve body so that the liquid is discharged via the discharge path; an operating rod connected to the valve rod and driving the valve rod to move relative to the valve body; a cam member including a through hole through which the operating rod passes and cam protrusions formed along a circumferential direction of the cam member based on the through hole and having inclined surfaces formed so that a height of the cam protrusions increases, the cam member being installed at the pump body so that the cam member rotates around the through hole; a rotating unit rotating the cam member; a cam follower including rollers that roll on the inclined surfaces of the cam protrusions when the cam member rotates, the cam follower coupled to the operating rod and driving the valve rod to move relative to the valve body; an accelerating member assembled with the cam follower to allow relative rotation of the cam follower within a predetermined angle range and installed at the pump body so as to make a linear motion approaching the cam member; and an elastic member installed between the pump body and the accelerating member and providing an elastic force to the accelerating member so that the accelerating member approaches the cam member.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features and advantages of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

FIG. **1** is a perspective view of a valve accelerating type dispensing pump according to an embodiment of the present invention;

FIG. **2** is an exploded perspective view of main elements of the valve accelerating type dispensing pump illustrated in FIG. **1**;

FIG. **3** is a cross-sectional view taken along a line of the valve accelerating type dispensing pump of FIG. **1**;

FIG. **4** is a cross-sectional view taken along a line IV-IV of the valve accelerating type dispensing pump of FIG. **1**;

FIGS. **5**A, **5**B, **6**A, **6**B, **7**A, and **7**B are schematic views for explaining an operation of the valve accelerating type dispensing pump of FIG. **1**; and

FIG. **8** is an exploded perspective view of main elements of a valve accelerating type dispensing pump according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention will now be described more fully with reference to the accompanying drawings in which exemplary embodiments of the invention are shown.

FIG. **1** is a perspective view of a valve accelerating type dispensing pump according to an embodiment of the present invention, FIG. **2** is an exploded perspective view of main elements of the valve accelerating type dispensing pump illustrated in FIG. **1**, and FIG. **3** is a cross-sectional view taken along a line III-III of the valve accelerating type dispensing pump of FIG. **1**.

Referring to FIGS. **1** through **3**, the valve accelerating type dispensing pump according to the present embodiment includes a pump body **100**, a valve body **110**, a valve rod **210**, an operating rod **220**, a cam member **300**, and a cam follower **400**.

The pump body **100** serves as a housing that supports the entire structure of the valve accelerating type dispensing pump. The pump body **100** is installed at a transfer device and is moved by the transfer device to allow a liquid to be dispensed.

The valve body **110** is installed at the pump body **100**. The valve body **110** includes an inlet path **111**, a reservoir **112**, and a discharge path **113**. The liquid stored in an external syringe (not shown) flows to the reservoir **112** via the inlet path **111**. The liquid stored in the reservoir **112** is discharged via the discharge path **113** due to an operation of the valve rod **210** that ascends/descends with respect to the reservoir **112**. A nozzle **120** is connected to the discharge path **113** so as to adjust dispensing characteristics of the liquid.

The valve rod **210** is inserted in the reservoir **112** and pressurizes the liquid stored in the reservoir **112** so as to discharge the liquid via the discharge path **113**.

The cam member **300** is disposed above the valve body **110** and the valve rod **210** and is installed at the pump body **100**. The cam member **300** is installed at the pump body **100** so as to rotate around a virtual central axis that extends in a lengthwise direction of the valve rod **210**. A bearing **130** is installed between the cam member **300** and the pump body **100** so that the cam member **300** may rotate with respect to the pump body **100**.

The cam member **300** rotates by a rotating unit **900**. The rotating unit **900** includes a motor **910**, a driving pulley **920**, a timing belt **930**, and a driven pulley **940**. The motor **910** is installed at the pump body **100**, and the driven pulley **940** is installed at the cam member **300**. The timing belt **930** connects the driving pulley **920** and the driven pulley **940**. If the motor **910** rotates the driving pulley **920**, the driven pulley **940** rotates due to the timing belt **930**. As a result, the cam member **300** rotates.

The cam member **300** includes a through hole **320** and a plurality of cam protrusions **310**. The through hole **320** is formed to penetrate the center of the disc-shaped cam member **300** in a vertical direction. The plurality of cam protrusions **310** are arranged in a circumferential direction of the cam member **300** so that eight cam protrusions **310** are at the same angle intervals (i.e., at intervals of 45 degrees). The cam protrusions **310** are inclined in the same rotation direction along the circumferential direction of the cam member **300**. That is, the cam protrusions **310** include inclined surfaces **311** that are inclined so that the height of the cam protrusions **310** may increase gradually clockwise, as illustrated in FIG. **2**. Cross-sections of the cam protrusions **310** may be formed so that the inclined surfaces **311** are steeply bent from their tops to lower portions. In the present embodiment, the inclined surfaces **311** of the cam protrusions **310** are formed to be bent from their tops in the vertical direction, as illustrated in FIGS. **2**, **5**A, and **5**B.

The operating rod **220** is disposed in the through hole **320** of the cam member **300** and is coupled to the valve rod **210**. The operating rod **220** is coupled to the cam follower **400** and ascends or descends and drives the valve rod **210** to be moved up and down relative to the valve body **110**.

The cam follower **400** faces a surface on which the cam protrusions **310** of the cam member **300** are formed and ascends/descends with respect to the cam member **300** due to interaction between the cam protrusions **310** and the cam follower **400**. The cam follower **400** includes two rollers **420** that roll on the inclined surfaces **311** of the cam protrusions **310**. Two rollers **420** of the cam follower **400** are disposed at intervals of 180 degrees.

The cam follower **400** is assembled with an accelerating member **500** and is installed at the pump body **100**. The accelerating member **500** includes a spline boss **530** and is coupled to the pump body **100** via a spline shaft **520** so as to make a linear motion (ascending/descending motion in the present embodiment) approaching the cam member **400** and not to allow relative rotation of the cam follower **400**. An elastic member **600** is disposed between the accelerating member **500** and the pump body **100** and provides an elastic force so that the elastic member **600** may be moved relative to the accelerating member **500** to approach the cam member **300**. In the present embodiment, the elastic member **600** having a shape of a spring **600** is used. The cam follower **400** that is disposed between the accelerating member **500** and the cam member **300**, receives the elastic force of the elastic member **600** from the accelerating member **500** and is maintained to be closely adhered to the cam member **300**.

The accelerating member **500** and the cam follower **400** are assembled with each other so that they may rotate relative to each other within a predetermined angle range. Due to interaction between accelerating protrusions **410** formed on the cam follower **400** and angle limiting portions **510** formed on the accelerating member **500**, the accelerating member **500** and the cam follower **400** may be rotated relative to each other within the predetermined angle range. In the present embodiment, the angle limiting portions **510** are long holes that extend in the circumferential direction of the accelerating member **500**. Two angle limiting portions **510** having a shape of long holes face each other in a state where a central axis (operating rod **220**) of the cam follower **400** is interposed between two angle limiting portions **510**. The accelerating protrusions **410** of the cam follower **400** are formed in the form of rods that extend in a radial direction of the cam follower **400** and protrude from the cam follower **400**. Like the angle limiting portions **510**, two accelerating protrusions **410** are disposed and face each other in a state where the central axis of the cam follower **400** is interposed between two accelerating protrusions **410**. The accelerating protrusions **410** are respectively inserted in the angle limiting portions **510** of the accelerating member **500**. Since the accelerating protrusions **410** are caught in inner walls of the angle limiting portions **510**, the cam follower **400** rotates with respect to the accelerating member **500** within an angle range that is allowed by the angle limiting portions **510**. That is, a relative rotational angle of the cam follower **400** with respect to the accelerating member **500** is limited by interference between the accelerating protrusions **410** and the angle limiting portions **510**. A range of the relative rotational angle of the cam follower **400** with respect to the accelerating member **500** that is limited by interaction between the accelerating protrusions **410** and the angle limiting portions **510** may be greater than 0 degree and less than angle intervals between the cam protrusions **310**. In the present embodiment, a rotatable angle of the cam follower **400** may be greater than 0 degree and less than 90 degrees. The rollers **420** are installed at ends of the accelerating protrusions **410** according to the present embodiment and roll on the inclined surfaces **311** of the cam protrusions **310** of the cam member **300**.

Hereinafter, an operation of the valve accelerating type dispensing pump having the above structure of FIGS. **1** through **3** will be described.

FIG. **4** is a cross-sectional view taken along a line IV-IV of the valve accelerating type dispensing pump of FIG. **1**, and FIGS. **5**A, **5**B, **6**A, **6**B, **7**A, and **7**B are schematic views for explaining an operation of the valve accelerating type dispensing pump of FIG.

Referring to FIG. **4**, the liquid stored in the external syringe flows to the reservoir **112** of the valve body **110** via the inlet path **111** under uniform pressure.

If the motor **910** operates in this state, the motor **910** rotates with the driving pulley **920**, and the driven pulley **940** that is connected to the driving pulley **920** via the timing belt **930**, also rotates. The cam member **300** that is coupled to the driven pulley **940** rotates with the driven pulley **940**.

If the cam member **300** rotates, the rollers **420** of the cam follower **400** roll along the inclined surfaces **311** of the cam protrusions **310**, and the cam follower **400** ascends. Since the accelerating member **500** is spline-coupled to the pump body **100** via the spline shaft **520**, the accelerating member **500** does not rotate but the rollers **420** roll along the inclined surfaces **311** of the cam protrusions **310** so that the accelerating member **500** and the cam follower **400** ascend. When the accelerating member **500** ascends, the elastic member **600** is pressurized while applying the elastic force to the accelerating member **500** in a downward direction. Due to the elastic force of the elastic member **600**, the rollers **420** of the cam follower **400** are maintained in contact with a top surface of the cam member **300**. The operating rod **220** that is coupled to the cam follower **400**, ascends with the valve rod **210**. When the valve rod **210** ascends, the liquid flows in a space formed in the reservoir **112**, and the space is filled with the liquid.

Referring to FIGS. **1**, **5**A, and **5**B, when the cam member **300** rotates, the accelerating protrusions **410** of the cam follower **400** are slid along the angle limiting portions **510** of the accelerating member **500** and are caught in left walls of the angle limiting portions **500** based on FIGS. **5**A and **5**B. Thus, rotation of the cam follower **400** does not proceed any more. That is, even when the cam member **300** rotates, the cam follower **400** does not rotate with respect to the accelerating member **500**. A concept of a state of force balance between the cam follower **400** and the cam member **300** is as shown in FIGS. **5**A and **5**B. A vertical resistance F_R applied to the rollers **420** on the inclined surfaces **311** of the cam protrusions **310** is balanced with a horizontal component force F_H and a vertical component force F_V that are applied to the rollers **420**. The vertical component force F_V is provided by the elastic member **600** and is transferred to the rollers **420** via the accelerating member **500**. The horizontal component force F_H is transferred to the rollers **420** via the pump body **100**—the accelerating member **500**—the cam follower **400**, because the accelerating protrusions **410** are caught in the angle limiting portions **510**.

If the rollers **420** roll up to tops of the inclined surfaces **311** of the cam protrusions **310** and ascend, the horizontal component of the vertical resistance F_R that is balanced with the horizontal component force F_H applied to the rollers **420** becomes extinct, as illustrated in FIGS. **6**A and **6**B. That is, on the inclined surfaces **311** of the cam protrusions **310**, a force is applied to the rollers **420** in the horizontal direction, and any force other than a frictional force is not applied to the rollers **420** in the vertical direction. As a result, due to the horizontal component force F_H applied by the angle limiting portions **510** to the accelerating protrusions **410**, the rollers **420** bounce off the cam protrusions **310** in the circumferential direction (right direction in FIGS. **5**A, **5**B, **6**A, **6**B, **7**A, and **7**B) of the cam member **300**, as illustrated in FIGS. **7**A and **7**B. As described above, since the cam follower **400** may rotate with respect to the accelerating member **500** within the angle range that is allowed by the angle limiting portions **510**, the cam follower **400** rotates with respect to the accelerating member **500** that does not rotate, in an opposite direction to a rotation direction of the cam member **300**, and the rollers **420** escape from the tops of the cam protrusions **310** at high speed. In this case, due to the elastic force of the elastic member **600**, the accelerating member **500**, the cam follower **400**, the operating rod **220**, and the valve rod **210** descend. As a result, the liquid filled in the reservoir **112** is pressurized by the valve rod **210** and is discharged via the discharge path **113**.

If the cam member **300** rotates consecutively and the rollers **420** ascend and descend along the cam protrusions **310** repeatedly, the valve rod **210** ascends and descends consecutively so that the liquid may be discharged via the discharge path **113**.

In the above liquid-pumping mechanism, the descending speed of the valve rod **210** greatly affects the discharge amount and discharge speed of the liquid. In order to adjust an accurate discharge amount, an inner diameter of the discharge path **113** may be relatively small. As the descending speed of the valve rod **210** increases, the liquid having high viscosity may be quickly dispensed via the discharge path **113** having a small inner diameter. In particular, when the viscosity of the liquid is high, if the descending speed of the valve rod **210** is not sufficiently high, due to resistance caused by viscosity and resistance of the discharge path **113**, the liquid may not be discharged. However, like in the present invention, the accelerating member **500** is used so that a liquid having high viscosity may be dispensed. In this way, by using the valve accelerating type dispensing pump according to the present invention, the range of the liquid that may be dispersed, may be greatly increased.

When there is no interaction between the accelerating protrusions **410** and the angle limiting portions **510** as described above, the descending speed of the valve rod **210** is determined by a rotational speed of the cam member **300**. As illustrated in FIGS. **6**A and **6**B, the rollers **420** should roll toward the cam member **300** by a distance D indicated in FIG. **7**A so that the rollers **420** may be moved from the tops of the cam protrusions **310** to the lowermost portion of the top surface of the cam member **300**, as illustrated in FIGS. **7**A and **7**B. In a valve dispensing pump having no accelerating member including angle limiting portions according to the related art, since a cam member should rotate in a state where a cam follower is fixed and rollers should roll up to a bottom surface of the cam member, the descending speed of the valve rod is determined by the rotational speed of the cam member. Even when an elastic member that provides a strong elastic force is used, the descending speed of the valve rod is substantially determined by the rotational speed of the cam member rather than the elastic force of the elastic member. In particular, when an outer diameter of each roller increases, a distance that is required for the rollers to contact the lowermost portion of the top surface of the cam member, increases so that the descending speed of the valve rod is also decreased by the distance.

However, in the valve accelerating type dispensing pump according to the present embodiment, when the rollers **420** roll along the inclined surfaces **311** of the cam protrusions **310**, the angle limiting portions **510** push the accelerating protrusions **410** in an opposite direction to the rotation direction of the cam member **300** by using the horizontal component force F_H applied to the rollers **420**, as illustrated in FIGS. **6**A and **6**B. The cam follower **400** rotates with respect to the accelerating member **500** due to a force applied by the angle limiting portions **510** to the accelerating protrusions **410** and rotates instantaneously in an opposite direction to the rotation direction of the cam member **300**, as illustrated in FIGS. **7**A and **7**B. As a result, the rollers **420** and the cam member **300** are moved in opposite directions, and the rollers **420** roll at much higher speed compared to the related art by the distance D at which the rollers **420** contact the lowermost portion of the top surface of the cam member **300**. Even when the rollers **420** having a relatively large outer diameter are used, due to interaction between the accelerating protrusions **410** and the angle limiting portions **510**, the rollers **420** may be moved relative to the cam member **300** at high speed, and the valve rods **210** may descend due to the elastic member **600** at very high speed. Since the momentum and kinetic energy of the valve rod **210** are proportional to a descending speed of the valve rod **210** and a square of the descending speed, the liquid may be dispensed at much higher speed compared to the related art. In particular, a liquid having high viscosity may be dispensed by a sufficient force via the discharge path **113** having a relatively small inner diameter.

If the rollers **420** contact next cam protrusion **310**, the cam follower **400** that rotates with respect to the accelerating member **500** in an opposite direction to the cam member **300**, rotates in the same direction as the rotation direction of the cam protrusions **310** due to the vertical resistance F_R of the cam protrusions **310**, and the accelerating protrusions **410** are caught in the angle limiting portions **510** in a progressive direction. When the angle range of the angle limiting portions **510** is less than the angle range between the cam protrusions **310**, the accelerating protrusions **410** are first caught in inner walls of the angle limiting portions **510**, and rotation of the cam follower **400** with respect to the accelerating member **500** stops. If the rollers **420** contact next cam protrusion **310**, the cam follower **400** rotates in the same direction as the cam member **300** so that the accelerating protrusions **410** are caught in opposite inner walls of the angle limiting portions **510** and rotation of the cam follower **400** stops.

To sum up, in the related art, even when an elastic force of an elastic member is strong, the descending speed of the valve rod is determined by the size of an outer diameter of a roller and a rotational speed of a cam member. However, in the valve accelerating type dispensing pump according to the present invention, due to interaction between the angle limiting portions **510** and the accelerating protrusions **410**, the descending speed of the valve rod **210** may be increased using a sufficient elastic force of the elastic member **600**.

Although embodiments of the present invention have been described as above, the scope of the present invention is not limited to the above-described embodiments.

For example, the accelerating protrusions **410** are formed on the cam follower **400**, and the angle limiting portions **510** are formed on the accelerating member **500**. However, the accelerating protrusions **410** may be formed on the accelerating member **500**, and the angle limiting portions **510** may be formed on the cam follower **400**.

Also, a bearing that rolls along the inner walls of the angle limiting portion **510** may be installed at the accelerating protrusions **410** so as to reduce friction between the accelerating protrusion **410** and the angle limiting portion **510**.

In addition, the angle limiting portions **510** have the shape of long holes, as described above. However, the angle limiting portions **510** may also be formed in the form of long grooves. The accelerating protrusions **410** and the angle limiting portions **510** may be formed in various shapes in which the accelerating member **500** and the cam follower **400** may rotate relative to each other within a predetermined angle range due to interference between the accelerating protrusions **410** and the angle limiting portions **510**.

Furthermore, the rollers **420** are installed at the accelerating protrusions **410**, as described above. However, the rollers **420** may be configured in different ways. The accelerating protrusions **410** interfere with the angle limiting portions **510** independently from the rollers **420** so that the rotational angle of the cam follower **400** may be limited, and the rollers **420** may be configured to be coupled to the cam follower **400** separately from the accelerating protrusions **410**.

FIG. **8** illustrates another example of accelerating protrusions **551** and angle limiting portions **452**.

The accelerating protrusions **551** are formed on an accelerating member **550**, and the angle limiting portions **452** are formed on a cam follower **450**. The angle limiting portions **452** of the cam follower **450** are formed in the form of long grooves having a circular arc shape on a surface that faces the accelerating member **550** along a circumferential direction of the accelerating member **550**. The accelerating protrusions **551** of the accelerating member **550** are formed in the form of rods that extend in a bottom surface of the accelerating member **550** and are inserted in the angle limiting portions **452** of the cam follower **450**. The cam follower **450** rotates with respect to the accelerating member **550** slightly, and the accelerating protrusions **551** are caught in the inner walls of the angle limiting portions **452** such that the cam follower **450** does not rotate any more. The remaining configuration of the accelerating protrusions **551** and the angle limiting portions **452** excluding the above configuration is the same as FIGS. **1** through **7**A and **7**B. If rollers **451** of the cam follower **450** roll along cam protrusions **310** in a state where the angle limiting portions **452** are caught in the accelerating protrusions **551** and the cam follower **450** cannot rotate, the angle limiting portions **452** are pushed by the accelerating protrusions **551** so that the cam follower **450** rotates with respect to the accelerating member **550**. As such, the relative speed between the rollers **451** and the cam member **300** increases, and the valve rod **210** may descend at high speed.

In the present embodiment, eight cam protrusions **310** and two rollers **420** are disposed. However, the number of cam protrusions **310** and the number of rollers **420** may be diverse. The shape of the cam protrusions **310** may vary according to their inclined angles and curvatures of inclined surfaces.

As described above, in a valve accelerating type dispensing pump according to the present invention, an accurate amount of a liquid may be dispensed at high speed.

Also, the valve accelerating type dispensing pump according to the present invention may dispense a liquid having high viscosity at high speed due to a fast descending speed of a valve rod.

While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims.

What is claimed is:

1. A liquid dispensing pump comprising:

a pump body;

a valve body comprising an inlet path to which liquid is supplied, a reservoir in which the liquid supplied via the inlet path is to be stored, and a discharge path through which the liquid stored in the reservoir is discharged, the valve body being installed at the pump body;

a valve rod configured to pressurize the liquid stored in the reservoir of the valve body so that the liquid is discharged via the discharge path;

an operating rod connected to the valve rod and configured to drive the valve rod to move relative to the valve body;

a cam member comprising a through hole through which the operating rod passes and further comprising cam protrusions formed around the through hole, the cam protrusions having inclined surfaces on which a cam follower travels, the cam member being installed at the pump body and rotatable about a rotation axis;

the cam follower comprising rollers configured to roll on the inclined surfaces of the cam protrusions when the cam member rotates, the cam follower coupled to the operating rod and configured to drive the valve rod to move relative to the valve body;

a can follower retainer engaged with the cam follower while permitting angular movement of the cam follower relative to the cam follower retainer about the rotation axis within a predetermined angular rang; and the cam follower retainer integrated with the pump body and linearly movable toward the cam member; and

an elastic member installed between the pump body and the cam follower retainer and configured to provide an elastic force to the cam follower retainer for pressing the cam follower retainer toward the cam member.

2. The pump of claim **1**, wherein projections are formed to protrude from one of the cam follower and the cam follower retainer, and angle limiting portions are formed on the other one of the cam follower and the cam follower retainer and configured to limit the angular movement of the cam follower relative to the cam follower retainer by interference between the projections and the angle limiting portions.

3. The pump of claim **2**, wherein the projections are formed on the cam follower and have a shape of rods that extend from the cam follower, and the angle limiting portions are formed on the cam follower retainer and have a shape of grooves or holes in which the projections are inserted and which are configured to limit the angular movement of the cam follower relative to the cam follower retainer within a circumferential length of the grooves or holes.

4. The pump of claim **3**, wherein the projections of the cam follower comprise a bearing configured to roll on inner walls of the angle limiting portion.

5. The pump of claim **4**, wherein the rollers of the cam follower are installed at the projections.

6. The pump of claim **2**, wherein the angle limiting portions are grooves that are formed in a circular arc along a circumferential direction of the cam follower, and the projections are rods that are inserted in the grooves.

7. The pump of claim **1**, wherein the cam protrusions of the cam member are arranged at the same angle intervals.

8. The pump of claim **7**, wherein the cam member comprises an even number of cam protrusions, and the cam follower comprises two rollers at intervals of 180 degrees.

9. The pump of claim **8**, wherein each of the cam protrusions of the cam member comprises the inclined surface ascending along a circumferential direction of the cam member at constant inclination, and further comprises another surface descending parallel to the rotation axis of the cam member.

10. The pump of claim **8**, wherein the cam follower is angularly movable with respect to the cam follower retainer within a range of an angle that is less than an angle between the adjacent cam protrusions and greater than 0 degrees.

11. The pump of claim **1**, further comprising a rotating unit which is configured to rotate the cam member and comprises a driven pulley connected to the cam member to rotate the cam member, a driving pulley installed at the pump body, a belt connecting the driving pulley and the driven pulley, and a motor that is configured to rotate the driving pulley.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 8,936,181 B2
APPLICATION NO. : 13/725720
DATED : January 20, 2015
INVENTOR(S) : Seung Min Hong et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Specification

Column 1, Line 8, change “May 24,” to --May 24, 2012--.

Column 4, Line 59, change “FIG.” to --FIG. 1--.

In the Claims

Column 8, Line 66, Claim 1, change “can” to --cam--.

Column 9, Line 2, Claim 1, change “rang;” to --range,--.

Signed and Sealed this
Twenty-second Day of September, 2015

Michelle K. Lee
Director of the United States Patent and Trademark Office